

SUMMARY

"DETERMINATION OF PERSONAL EXPOSURES TO ENVIRONMENTAL TOBACCO SMOKE IN BRITISH NON-SMOKERS"

A FINAL REPORT FROM HAZLETON LABS

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Two hundred fifty-five British volunteers were recruited for this study. All volunteers wore personal monitors for assessing ETS exposure for twenty-four hour periods. Ambient air measurements were taken for exposure to particles from all sources, particles associated with ETS and nicotine. In addition, subjects supplied saliva samples for cotinine and completed questionnaires about estimated smoke exposures and general lifestyle habits.

The specific objectives of the project were:

1. To determine the range, mean and median levels of twenty-four hour exposure to nicotine and to ETS particles for non-smoking British volunteers;
2. To assess the contributions to total ETS exposure from the home, the workplace, leisure and travel;
3. To assess whether non-smokers who are married to smokers have significantly higher exposures to ETS than non-smokers married to non-smokers; and
4. To compare questionnaires, direct measurements and salivary cotinine levels as methods of assessing exposures to ETS.

Sampling, measurement and analytic techniques selected for the study were state-of-the-art. The contribution of ETS to total particulate exposures was assessed by UV, fluorescence and solanesol analyses. In addition, 3-ethenylpyridine was also measured simultaneously with nicotine.

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The results indicate that average exposure to ETS constituents was low for nearly all subjects. Overall levels for ETS-related particles were  $12 \text{ ug}/\text{m}^3$  and  $1.7 \text{ ug}/\text{m}^3$  for nicotine. ETS particles contributed only seven percent of the total particulate exposure for non-smokers. The ratio of ETS-related particulate to total particles was 31 UVPM/179 RSP.

The exposure levels measured are in agreement with results from other studies, indicating that personal monitoring techniques and analytic methods used in the study are appropriate. Seventy percent of all subjects had exposure levels of less than  $10 \text{ ug}/\text{m}^3$  for particulate matter related to ETS. Sixty percent of the subjects were exposed to less than  $1 \text{ ug}/\text{m}^3$  of nicotine and eighty-five percent of the subjects were exposed to less than  $5 \text{ ug}/\text{m}^3$  of nicotine. These values agree with subjective assessments of exposure in that over eighty percent of the studied subjects described their exposure levels as "none" to "low".

The authors attempted to rank relative contributions of ETS for work, home, travel and leisure venues. They compared data gathered through questionnaires about relative contributions of ETS from each venue with actual measurement data from individuals with exclusive exposures to a single venue. The results indicate that subjective estimates of exposure tended to rank as higher relative contributions from leisure, work, home and travel, respectively, whereas direct measurements indicated that the ranking of relative contributions to total ETS exposure is: home, leisure, work and travel. Subjective assessments appear to overestimate contributions of ETS from workplace and leisure venues.

Mean exposure levels for various ETS constituents for subjects with a smoking spouse or partner were greater than for those with a non-smoking spouse or partner, but the distribution of the results does not provide a clear distinction between the two groups. Forty-six percent of subjects with a smoking spouse or partner assessed their ETS exposure as "none" or "low". This assessment was supported by direct measurements. Approximately thirty percent of subjects with a smoking spouse or partner assessed leisure or work as their principal source of exposure.

The final objective of the study was to compare questionnaires, direct measurements and salivary cotinine levels as methods for assessing exposure to ETS. Direct measurements by personal monitoring appear to provide the most reliable estimate of ETS exposure. While there was a general tendency for measured exposures to increase with higher subjective assessments of exposure, considerable variation between direct measurements at higher levels and considerable overlap in measured exposures for the various grades of subjective assessments can be seen. A similar situation exists for salivary cotinine measurements and correlations with questionnaires. Data from the study indicate

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that salivary cotinine levels correlate very poorly with direct measurements of ETS constituents. Some subjects who had been exposed to high levels of ETS-related particulate and nicotine had no detectable salivary cotinine, and subjects who had not been exposed to any measurable quantity of nicotine had relatively high levels of salivary cotinine. ETS-related particulate determined by solanesol was only moderately correlated with nicotine measurements. A better correlation existed between nicotine and 3-ethenylpyridine.

This is an important study and potentially a valuable contribution to the literature. It demonstrates the viability and accuracy of personal monitoring for ETS constituents, including particulates from all sources, ETS-related particles, nicotine and 3-ethenylpyridine. The study also reaffirms the inaccuracy in the use of questionnaires for the assessment of ETS exposures, and the use of cotinine as a quantitative marker for assessing ETS exposures. The overall results indicate relatively low contributions of ETS-related constituents to total pollutant burdens for individuals across a number of venues. The data tend to undermine the claims that ETS exposures are "ubiquitous" and that levels of exposure encountered at work are inordinately high.

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